attend to the health of the slaves and so long as provisions and water did not run short great care was taken of the slaves, and the Surgeon received a capitation payment of one shilling for every slave landed in good health, but he had no responsibility for the officers and crew. Many of the witnesses for the Committee complained of the way the crews were treated. One seaman gave evidence that he was cruelly beaten both by the captain and the surgeon, that he was half starved and that the surgeon neglected the sick seamen, alleging that he was only paid for attending the slaves.

Australia

Collins and Browning both bear witness to the careful provision by the Government for the convicts on the ships that sailed to Australia and Van Diemens Land. Sanitation was well looked after and exercise, education, religious instruction, clothing and diet all come under the survey.

West Indies

Although the West Indies had a terrible reputation for sickness the actual voyage to and fro was not exceptionally unhealthy. It was on land and in port that yellow fever made its ravages and gave the "Station" its bad name; but Trotter mentions that communication with the shore produced yellow fever. "The disease," he observed, "uniformly disappeared from ships as they increased their distance from the West Indies. At 32° North no fresh attacks were known." Bancroft, writing in 1811 on yellow fever and other contagious fevers, lays stress on the short distance some contagious fevers could pass over the sea. He gives many quotations showing how short was the distance from shore that the malarial infection could travel and observes that Blane put it at two cables length in Jamaica.

Missionary Voyages and Tourist Travel

Missionary voyages and tourist travel complete the sum of the voyages belonging to the last part of this account. Wilson's voyage in "The Duff" (1796-98) is one of the best records. He says: "We had run from the time of leaving England upwards of 34,000 miles and had been out fourteen months, eleven of them at sea; yet in all this time we had scarcely experienced any sickness and were at present to a man in good health." It is difficult to obtain a clear impression of ordinary passenger or tourist travel. Such information as we possess comes mainly from private diaries and the sanitary conditions are rarely dwelt upon. Fielding's voyage to Lisbon in 1754 gives a vivid picture of the difficulties of obtaining medical relief, in the first instance for himself when his dropsy required tapping, and in the second place for his wife who tried to get a tooth extracted. Sir Francis Darwin visited Spain and Portugal when the Peninsular War was at its height. He describes some of the perils of the voyage as being intermittent fever at Cadiz, plague at Smyrna, shock from a torpedo-fish whilst bathing and typhus from which his friend Galton died at Malta. His diary also deals with quarantine.

A Schoolgirl's Note

One of the most intimate sketches of sickness on board ship is given in "Letters to Jane from Jamaica". One of Jane's school friends who wrote on March 9, 1792, says: "While the blowing weather lasted we were sadly frightened. Could you have seen us you would have laughed, such a group of figures drawn up in different parts of the cabin, eating off the ground, fed by my brother and the mate, as for the mean sneaking doctor he was such a coward that he kept in bed."

Records in the Older Literature of Tissue Changes in Scurvy

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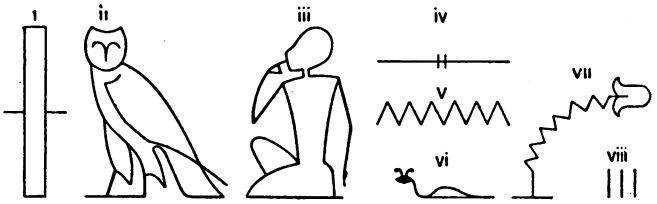
"Nature", said Goethe, "reveals herself best in her abnormalities." In studying the role of vitamin C in the regeneration of bone, or in any of its functions in the body, attention must therefore be paid to that abnormal state which results from the complete deprivation of vitamin C—scurvy. Scurvy is a rare disease to-day, so that to obtain full information of its effects we must turn to the writings of earlier workers who were able to study many cases of the disease.

There is little doubt that scurvy has been known for many centuries. Ebbell (1938) in an analysis of various ancient Egyptian papyri, states that the following hieroglyphs represent scurvy. He provides quite good evidence that the hieroglyphs iv, v, vi, vii and viii indicate a disease characterized by petechial hæmorrhages in the skin. Also, it has been pointed out to the present author that the determinative hieroglyph iii which indicates a little man pointing to his mouth, and the hieroglyph vii which represents blood oozing from a lesion, may indicate that the disease represented by these hieroglyphs is also characterized by bleeding gums. Since bleeding gums and petechial hæmorrhages are characteristic of scurvy, it seems likely that scurvy was known over three thousand years ago in Egypt (the estimated age of the Ebers papyrus from which Ebbell obtained the major portion of his material).



Egyptian hieroglyphs believed to indicate scurvy (*see text*).

Hirsch (1885) has made a critical analysis of the writings of the ancient authors which are presumed to have described scurvy, Hippocrates, Celsus, Aretæus, Caelius, Aurelianus, Paulus, Aegineta and Avicenna. These physicians described a disease called "lines magni" which has been interpreted by various authors (e.g. Guyon, 1846) as scurvy. Hirsch points out that one of the characteristics of this disease is an enlarged spleen which is not a common feature of scurvy, and he believes that the disease described by these ancient authors was, in fact, malaria. Another ancient disease, Pliny's "stomakake", which affected the Roman armies under Germanicus in the Low Countries. is regarded by Hirsch simply as an ulcerative stomatitis, and not as scurvy at all. Another ancient disease, said to be scurvy, was "skeletyrbe", but Hirsch states that Galen's description of the peculiar gait in people suffering from it reminds him of tabetic patients. After a close scrutiny of the literature, Hirsch comes to the conclusion that only in the writings of Hippocrates is there a description of a disease which can unequivocally be regarded as scurvy.

From the cacodoxical attempts of various writers to refer the occurrence of scurvy as far back into antiquity as possible, we come to the far more reliable records of Jacques de Vitry (1873) and de Joinville (1250) of the disease which beset the crusading armies of Louis IX before Cairo. De Joinville mentions blackening of the limbs and fungating gums. The following is his description (taken from Menard's 1617 edition of his writings: the Mediæval French spelling is not altered):

"Et de ce . . . nous vint une grant persecution et maladie en l'ost; qui estoit telle, que la chairdes jambes nous desscheoit jusques à l'os et le cuir devenoit tanne de noir et de terre, à resemblance d'une vieille houze, qui a esté long temps mucée derriere les coffres.

"Et outtre, à nous autres, qui avions cette maladie, nous venoit une autre persecution de maladie en la bouche, de ce que avions mengee de ces poissons, et nous pourissoit la chair d'entre les gencines dont chacun estoit orriblement puant de la bouche."

The outbreak of this disease was thought to be due to the fact that the crusaders ate fish which had fed on the bodies of men killed in battle, floating in a nearby river.

Lind (1753) says that de Joinville's records constitute the first record of true scurvy which he has met with in the ancient literature. The first accounts of scurvy as such were given, according to Lind, by Ronfleus, Echthius and Wierus. Presumably these writers first used the term "scorbutus" or scurvy, but it is not clear either from Lind or from Hirsch who first provided a name for the collection of symptoms which eventually became known as scurvy. Hirsch identifies a disease called by Cordus (who apparently wrote between 1500 and 1600: Hirsch does not quote him in his bibliography) "Scharboch" with scurvy. An epidemic occurring in 1486 was described by Fabricius by this name, according to Hirsch.

Echthius and Wierus gave the most complete descriptions of the disease, which were quoted in detail by subsequent authors, notably Solomon Albertus and Eugalenus. Echthius, according to Lind, described the disease as being characterized by a "spongy swelling of the gums, which are apt to bleed, with a loosening of the teeth: an eruption of leaden-coloured, purple or livid spots on the legs: or of somewhat broader speckled or dark-coloured maculæ, sometimes on the face, at other times on the legs. As the disease advances, the patients lose the use of their legs, and are subject to a difficulty of breathing".

To this description Wierus added that the weakness of the legs "is attended with a stiffness there. The flesh of the gums is often destroyed to the roots of the teeth. Smaller spots, resembling blood sprinkled upon the part (or flea-bites, but larger) appear on the legs, thighs, and on the whole body: . . . in the progress of the disease the tendons of the legs become stiff and contracted. . . . The urine is reddish, turbid, thick and fæculent, like new-red wine. . . . if ulcers break out on the tibia, they are with great difficulty healed up, being extremely fœtid, of a gangrenous disposition. . . ."

Eugalenus (1604) also mentioned, I. Putrid gums; II. Blackish, purple and livid spots; III. Malignant ulcers; as characteristic of scurvy. Many other early authors (*see* Lind, 1753, for details) have described similar conditions.

Kramer (1720), an Austrian army surgeon, described the disease in the Imperial troops in Hungary and made the interesting observation that the officers did not get it (presumably because of better diet). It is of interest that this has been the case in most armies and often at sea. It was particularly noticeable during the American Civil War. Kramer also mentioned the bleeding, swollen gums and stated that often the teeth fell out. In the second stage of the malady he said that there was apparently a contraction of the joint of the knee because the patient was unable to straighten his leg. The joints became very swollen and painful. Even the eyes were covered with blood spots in some of Kramer's cases. Caries of the jaw was another symptom and so were hæmorrhages from the lungs, stomach and intestines.

In Walter's (1748) account of Lord Anson's voyage round the world it is stated that the constantly occurring symptoms of the disease were "large discoloured spots dispersed over the whole surface of the body: swelled legs: putrid gums: and above all an extraordinary lassitude of the body".

Scurvy decimated both sides in the American Civil War (*see* Major Charles Smart's *Medical and Surgical History of the War of the Rebellion*, 1888). The army of the Potomac had 30,000 cases of scurvy in five years. Scurvy was more prevalent among the Confederates because their food was worse than that of the U.S. army. The army surgeons in the American Civil War claimed that the characteristic pre-symptom of scurvy in the man was rheumatism. The various conditions found in cases of scurvy during that war were œdematous limbs, stiff and painful joints, petechiæ on the lower extremities, peritoneal, pleural and pericardial hæmorrhages, gums almost totally destroyed, roots of teeth carious, hæmaturia, bloody diarrhœa, large purplish spots (ecchymoses).

In the Crimean war (see *Medical and Surgical History of the British Army in the Crimea*, 1858) Dr. Linton describes "spongy bleeding gums" in the 1st Division before embarkation from Bulgaria for the Crimea. Other surgeons described aching pains in the ankles and feet, purpuric spots on the lower limbs, bleeding from the nose, hæmorrhage from the bowels and hæmatemesis.

According to Sir W. H. Willcox (*Official History of the War*, 1922) cases of scurvy in the last war showed petechial spots, gum changes, hæmorrhages into palate, skin, muscles, joints, periosteum. Pyorrhœa was often present and was said to be a secondary condition of the scorbutic changes.

The first post-mortem examination of persons who had died of scurvy was made during Jacques Cartier's voyage up the Gulf of the St. Lawrence (1535). Post-mortem examinations were also made by Lind (1753) and by Barlow (1894), who identified infantile and adult scurvy. Greater details were given by Aschoff and Koch in 1919, but there are 31 other references to the results of post-mortem examinations of scurvy between Lind's account in 1753 and that of Aschoff and Koch in 1919.

Bone Changes in Scurvy

Lind found that the blood of persons who had died of scurvy did not clot, whether it was left in the body or whether it was withdrawn into a vessel. The lungs were

"blackish and putrid" and the muscles "stuffed with a black corrupted blood". Some bodies when moved could be heard grating and when they were opened the epiphyses of the long bones were found to be entirely separated away. Some persons when alive had been heard to make a "small low noise when they breathed". In these, the cartilages of the sternum were found to be separated from the bony parts of the ribs. In some, the ribs were carious and in nearly all the ligaments of the joints were corroded and loose. Abnormalities in the bones appeared to be a constant feature of scurvy and there are ten publications on post-mortem changes in scurvy between 1883 and 1918 in which only the changes in the bones are described. Lind noted also the presence of what Hess (1920) has subsequently described as "peculiar boggy tumour-like masses of localized œdema", and regarded them as typical of scurvy. He also found that the "breast, belly and several other parts of the body were filled with water or serum". Barlow (1894) wrote also "the muscular walls of the thorax were pale yellow and watery, as though they had been bathed in serum".

Aschoff and Koch and Hess stressed the fact that the characteristic lesions of scurvy are those of the bones. The epiphyses in all young persons have been separated from the bones and in young children there has been found a bending of the ribs, wrongly ascribed (according to Hess) to the effects of vitamin-D deficiency, i.e. rickets, actually the two diseases give different types of beading. Scorbutic monkeys have also been shown to develop beading of the ribs (Hart and Lessing, 1913).

Effect of Scurvy on the Repair of Tissues

Since the earlier evidence suggests that in scurvy there is an upsetting of the normal functioning of both soft and hard tissues, one would expect that repair of injury to any tissue would be delayed in scurvy. That this is a fact can be confirmed further by reference to the older literature.

The earliest known record of the effects of scurvy on wounds is given by Richard Walter (1748), chaplain to Lord Anson's expedition round the world (1740-1744). He made the following comments on this subject.

"At other times the whole body, but more especially the legs, were subject to ulcers of the worst kind, attended with rotten bones, and such a luxuriancy of fungous flesh, as yielded to no remedy. But a most extraordinary circumstance, and what would be scarcely credible upon any single evidence, is, that the scars of wounds which had for many years healed, were forced open again by this violent distemper: of this, there was a remarkable instance in one of the invalids upon the 'Centurion', who had been wounded above fifty years before at the battle of the Boyne: for though he was cured soon after, and had continued well for a great number of years past, yet on his being attacked by the scurvy, his wounds, in the progress of his disease, broke out afresh, and appeared as if they had never been healed: Nay what is still more astonishing, the callus of a broken bone, which had been completely formed for a long time, was found to be hereby dissolved, and the fracture seemed as if it had never been consolidated."

Lind (1753) made the following observation (p. 151): "When one had been confined from exercise by having a fractured bone, or from a bruise or hurt, these weak and debilitated parts become always the first scorbutic." Mr. Ives, writing to James Lind (Lind, 1753, p. 151) of the breaking open of wounds in scurvy, refers to the case of a seaman on H.M.S. "Dragon" who had a shattering of the humerus from a Spanish musket ball. Union of the bone and healing of the skin wounds had been brought about by November, and when in December scurvy broke out on the ship, he fell a victim to the disease, the first symptom being the breaking open of the wounds in his arm. Lind also records that the "slightest bruises and wounds of scorbutic persons degenerate in such ulcers . . . distinguished from all others by being so remarkably putrid, bloody and fungous".

Mead (1762) quoted the case of a sailor who had suffered from a fractured clavicle which had apparently healed normally and which broke again four months later when the sailor was suffering from scurvy. Six months after this, after the sailor had been on a diet of green vegetables for some time, the fracture re-united.

Marrigues (1783), Bell (1788), Callisen (1798) all found softening of the callus of old fractures of bones in scurvy, sometimes with a separation of the ends of the bones. Hammick (1830) reported a number of cases of spontaneous refracture of bones and pointed out that it was impossible to secure the uniting of a fracture so long as the

patient had scurvy. A further example of refracture of a healed broken bone is given by Budd (1840).

Dr. Linton (quoted in the *Medical and Surgical History of the British Army which Served in Turkey and the Crimea,* 1858) described the case of a grenadier aged 23 with a broken humerus. This man broke his arm while carrying a log of wood across some frozen snow. After he had been put in hospital, old ulcers on his leg opened up and his gums became spongy. The callus which formed at the site of the fracture in the humerus was unusually small (suggesting a reduced inflammatory reaction to injury). Only when this man was put on a "good" diet did his fracture unite and his ulcers heal.

Moore (1859) has recorded two cases of fracture of the forearm in which healing was prevented because the patients also had scurvy. Moore stated that this disease has a "powerful effect in retarding the consolidation of fractures".

Major Charles Smart (in the *Medical and Surgical History of the War of the Rebellion*) pointed out that as a result of the scurvy which broke out among the combatant armies of the American Civil War the wounds failed to heal and slight abrasions, such as the rubbing of a shoe, a bruise, the scratch of a mosquito bite, the prick of a splinter, or vaccination scars, tended not only not to heal, but to turn into scorbutic ulcers.

Dr. Eve (1866) stated that in the Confederate Armies during the Civil War the occurrence of scurvy "complicated wounds and seriously interfered with surgical operations". Surgical hæmorrhage was much more frequent as the war progressed.

Even during the last war, Lobmayer (1918) claimed that the Turkish soldiers suffered severely from scurvy and that in those who developed the disease both skin and flesh wounds and fractures healed poorly. In many cases the fractures showed not the slightest sign of the formation of a callus, even after several months. In confirmation of the fact that it was lack of the antiscorbutic substance which was directly responsible for this failure of fractures to unite, he quoted two cases who suffered from pseudo-arthrosis of the humerus and who recovered rapidly and completely as soon as they were put on a diet which was rich in antiscorbutic material.

The study of the older literature of scurvy has thus shown us that the disease is not only characterised by hæmorrhagic symptoms but that there are tissue changes as well, particularly in the bones. There is confirmation too, that scurvy delays the healing of wounds of both skin and bone.

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